Xcerpt: Versatile Query Constructs and Data Model

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Motivation

- Semantic Web is gaining momentum
- Query languages are an accepted means for processing Semantic Web data: SPARQL, RQL, etc.
- Query languages are also an accepted means for processing XML data: XQuery, XSLT, Xcerpt
- Both Semantic Web data and XML applications are semi-structured.
- Common language constructs and a common data model can be identified.

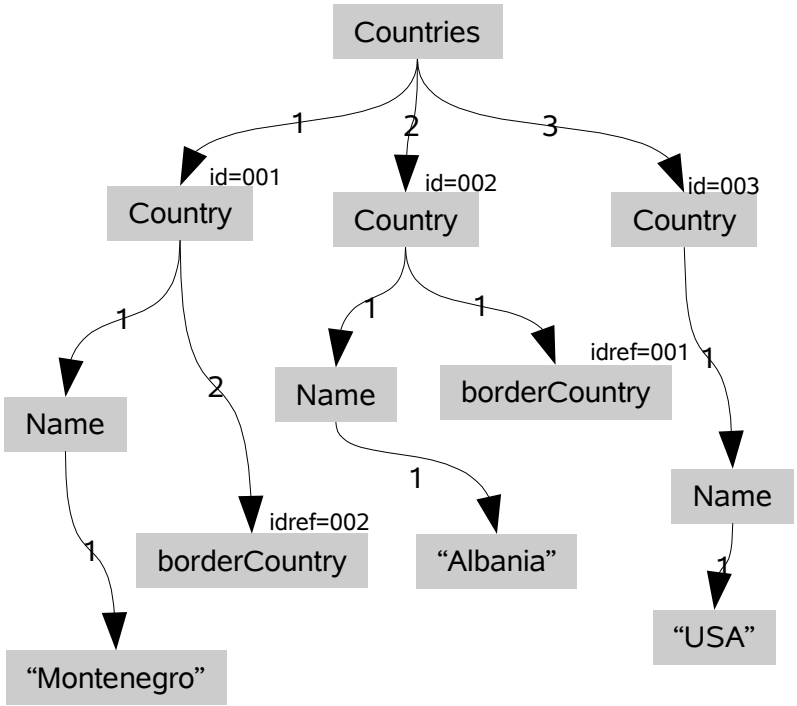
Outline

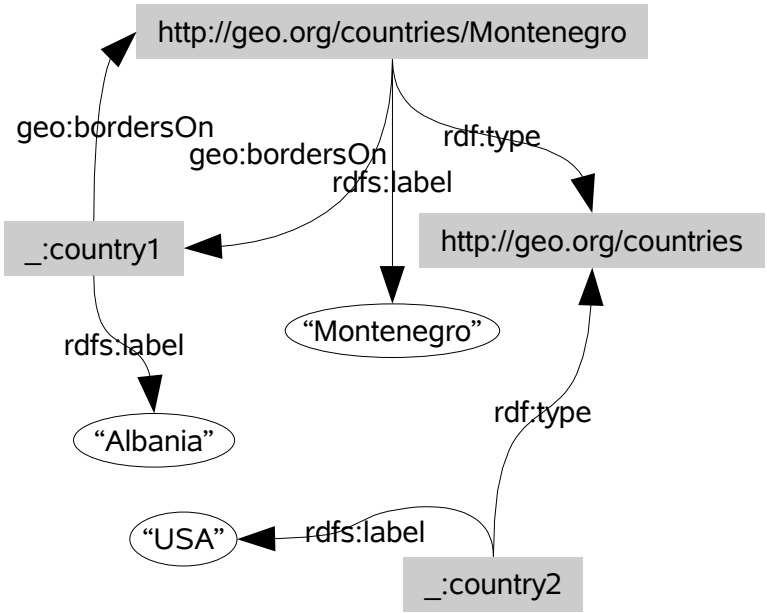
- Motivation
- A quick introduction to Xcerpt
- Comparison of RDF and XML data
- RDF graphs as Xcerpt data terms
- Common Language Constructs for Querying
- Common Language Constructs for Construction and Transformations

Quick Overview over Xcerpt

- Rule based query language
- Rich query patterns: *query terms* with logical variables
- Substitution sets: Sets of sets of variable bindings
- Construct terms: templates for constructing results
- Construct and query terms are connected by rules
- Evaluation of Rules with Backward Chaining

XML versus RDF data





Challenges for the Data Model

- Representation of graphs, not only trees
- Purely node-labeled graphs as well as node- and edge-labeled graphs
- Provision for XML-specificities (Attributes, id, idref, namespaces, entities, etc)
- Provision for RDF-specificities (Blank-Nodes, Literals, Containers and Collections)

RDF Graphs as Xcerpt Data Terms

```
geo:Montenegro {
    <geo:bordersOn> _:country1{
        <geo:bordersOn> geo:Montenegro,
        <rdfs:label> literal('Albania'),
    }
    <rdfs:label> literal('Montenegro'),
    <rdf:type> geo:country,
}

_:country2 {
    <rdfs:label> literal('USA'),
    <rdf:type> geo:country
}
```

Common Language Constructs for Querying

Computing all countries that transitively border to Montenegro:

```
var Country -> /.*/{{
   <rdf:type> geo:country{{ }},
   desc (<geo:bordersOn> /.*/)*
      <geo:bordersOn> geo:Montenegro{{ }},
   optional <rdfs:label> var Name -> literal(/.*/)
}}
```

- Constructs for handling incompleteness
- Arbitrary length traversal path expressions
- Optional subterms
- Logical variables with structural restrictions

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The Semantics of the Optional Construct in Sparql and Xcerpt

```
_:x rdfs:label 'Germany'
_:x geo:bordersOn Austria
_:x football:looses_sometimes_against England

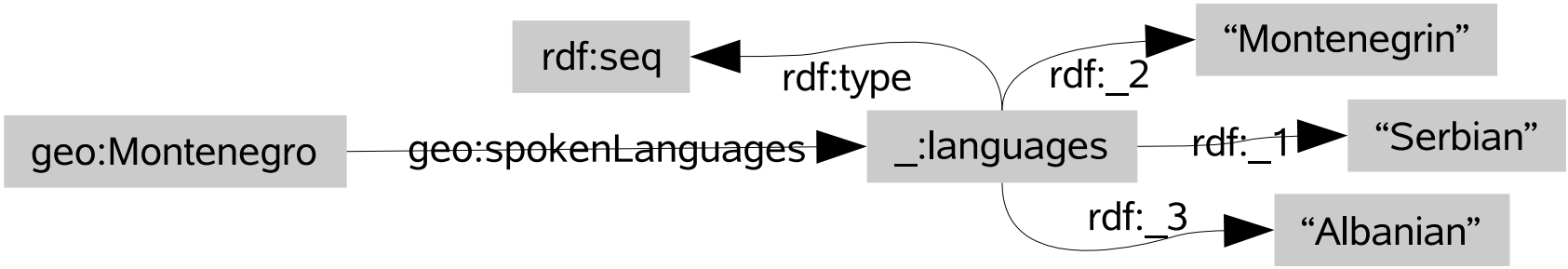
Var X -> /*./ {{
   <rdfs:label> literal('Germany'),
   optional <geo:bordersOn> Y,
   optional <football:looses_sometimes_against> Y
}}
```

- in Sparql: one Substitution: $\mathtt{Y} \mapsto$ Austria, $\mathtt{X} \mapsto$ Germany
- in Xcerpt: two Substitutions: one for Austria, one for England.

Other Xcerpt query constructs beneficial to the SW

- Breadth-complete queries
- Negation as Failure
- Injectivity constraints on siblings
- Order constraints on siblings (for RDF-Sequences)

Ordered and Breadth-complete queries




```
var Country -> /.*/{{
   <geo:spokenLanguages> /.*/ [
      </.*/> literal('Serbian'),
      </.*/> literal('Montenegrin'),
      </.*/> literal('Albanian')
   ]
}}
```

Grouping Constructs

- Most RDF query languages do not support sophisticated construction
- Deduction versus Transformation

```
CONSTRUCT
    _:language{
       <rdfs:label> var Language,
       all <geo:spokenIn> var Country }
FROM
    var Country -> /.*/{{
       <geo:spokenLanguage> /.*/{{ </.*/> var Language }} }}
END
```

Versatile Access to Web Data with Xcerpt

```
CONSTRUCT
   result[ all understanding-neighbors[ var Name1, var Name2 ] ]
FROM
   and (
      in{ resource{ 'http://geo.org/countries.xml' },
         Countries {{
            Country((var ID -> id)){{ Name{ var Name1 } }},
            Country{{
               borderCountry((var ID -> idref)),
               Name{ var Name2 } }} }} },
      in{ resource{ 'http://geo.org/languages.rdf' },
         /.*/{{
            <rdfs:label> var Name1,
            <geo:spokenLanguage> /.*/[ <rdf:_1> var Language ] }},
         /.*/{{
            <rdfs:label> var Name2,
            <geo:spokenLanguage> /.*/[ <rdf:_1> var Language ] }} }
   ) END
```

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         /.*/{{
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            <geo:spokenLanguage> /.*/[ <rdf:_1> var Language ] }},
         /.*/{{
            <rdfs:label> var Name2,
            <geo:spokenLanguage> /.*/[ <rdf:_1> var Language ] }} }
   ) END
```

Conclusion

- RDF and XML being complementary data formats makes integrated querying even more important.
- Xcerpt's data model, query constructs and rules are well suited for native RDF processing.
- Xcerpt's incompleteness specifications are powerful tools for querying also RDF data
- Access to both standard Web and Semantic Web data in a single query language is valuable and possible.

Future Work

- Adjustment of Xcerpt's implementation to RDF
- Adaption of simulation unfication to RDF graphs
- Incorporation of RDF/S and OWL reasoning capabilities
- Further optimization of Xcerpt's backward chaining algorithm

Thank You!
Questions?